UNIVERSITI TEKNOLOGI MARA

SG. SERAI WATER CHARACTERIZATION AND COAGULATION STUDY

SAFRINA MOHD AZIZ

Dissertation submitter as a
partial requirement for the degree of
Master of Science in Civil Engineering
(Environmental Engineering) (EC 774)

Faculty of Civil Engineering

MAY 2010

ABSTRACT

The Sg. Serai Water Treatment Plant is a partial water treatment which only treats raw water with turbidity less than 5 NTU. Recently, the raw water turbidity increased to 6-8 NTU due to several landslides at the upstream of the intake. The low turbidity water in Sg Serai is hard to coagulate due to low concentration of particles. Study on different coagulants and optimization of the coagulant dosage on Sg. Serai raw water essential to ensure the WTP can be operated to produce treated water that comply with the Malaysian Drinking Water Quality Standard and Concession Agreement. Nine water quality parameters were conducted to characterize the Sg Serai raw water prior to coagulation study. Forty- one jar tests were conducted for coagulation and flocculation study to determine optimum dosages and pH for coagulation process. In addition, the jar tests were conducted to evaluate the performance of selected aluminium based coagulant with and without pre-treatment. Furthermore, filtrations test conducted to evaluate the effectiveness of the combined coagulation and filtration in treating raw water. The characterization of raw water showed that TOC and color are very low thus may not dominant in affecting optimum coagulation dosage. The pH and alkalinity is also low which 6.23 mg/L and 3.4 mg/L respectively, demanding the pre- treatment such as pH correction and water softening. The low turbidity in raw water containing small colloid particles (0.5658 μm) also raise problem in optimization of the coagulation process due to less collision between particles. The zeta potential is –28mV showed high negative charge on colloids that much need to be reduced to the range of 0 mV to –10 mV for optimum coagulation process. The study discovered that the optimum pH for coagulation process using alum without pre- treatment is pH 4.3 to 6.38 and pH 5.23 to 7.71 with pre-treatment. While the optimum pH coagulation for PAC without pre- treatment is pH 4.54 to 7.24 and pH 5.06 to 6.52 with pre- treatment. The optimum dosage for alum for was at 15 mg/L with 96.5 % turbidity removal. The optimum dosage of PAC was smaller compared to Alum at 5 mg/L PAC with 64.1% turbidity removal. Thus, the result showed that the alum is the most effective in removing turbidity in Sg. Serai raw water compared to PAC. The coagulation with pre- treatment is effective with pre- treatment for both alum and PAC. Alum is the most effective with pre- treatment with 98.6% turbidity removal. pH adjustment is important for optimization of alum coagulant due to its smaller optimum pH range. The filtration had removed 21.7% and 32.7% turbidity of settled water when alum and PAC was used as coagulant in clarification process respectively. Thus, the combination of coagulation, flocculation, sedimentation and filtration were effective and efficient to remove turbidity of Sg. Serai water with pre- treatment in using alum and PAC.

Keywords: Optimization of coagulation, coagulation, Aluminium Sulphate, PAC

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1. General Introduction

Water found in nature is never pure. Water is an excellent solvent that can dissolve most minerals that come in contact with it. For this reason, there is no such thing as pure water in nature. It always contains physical, chemical and biological impurities. These impurities originate from natural sources, leaching from waste deposits or direct introduction of pollutant to the body of water. Due to these impurities, water needs to be treated before it can be safely used. Besides health concern, the aesthetic appearances such as colour, taste and odour of the treated water constitute major concerns to public.

Water supply system in Malaysia was first introduced in 1804 by the British in Pulau Pinang, where an aqueduct of brick was constructed to transport untreated water from Ayer Itam River to the town. As awareness to prevent outbreak of water borne- disease increased, water treatment plant was introduced in Malaya and water was treated before delivered to the consumers in early 1930 (Kheong, 2008 and JKR, 2007).

By 1950, Malaya had 100 water treatment plants producing 195 million litres of water per day (MLD) to supply a population of 1.15 million (JKR, 2007). Most of these water treatment plants are conventional types, while some are partial water treatment plants where is water treated without clarification and filtration processes. Most of these water treatment plants are still in operation to the present day.